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Abstract

Four experiments were conducted to evaluate Fish Protein Hydrolysate (FPH) as a protein source in starter diets for pigs. A total of 552 weaned pigs were used in three growth trials and one digestion study. All three growth trials were designed to determine the effect of FPH with and without dried whey on starter pig performance. The digestion study was designed to determine the effect of FPH with and without dried whey on nutrient digestibility. Adding 3% FPH to starter pig diets resulted in an improvement (8-17%) in average daily gain (ADG) over a corn-soybean meal basal diet. Feed efficiency and average daily feed intake (ADFI) were not affected by the addition of FPH. Dried whey additions with or without FPH resulted in no improvement over performance observed with the 3% FPH diet in either Trial 1 or Trial 3. In Trial 4, 20% dried whey added to a corn-soybean meal diet improved performance for all criteria measured to a level equal to that with 3% FPH alone. Growth responses to the addition of dried whey were inconsistent from trial to trial, possibly because whey utilization may have been impaired by heat damage to the dried whey. Therefore, conclusions regarding dried whey additions with or without FPH may be confounded with dried whey quality.; Swine Day, Manhattan, KS, November 21, 1985

Keywords

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EFFECTS OF FISH PROTEIN HYDROLYSATE AND DRIED WHEY IN STARTER PIG DIETS

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Summary

Four experiments were conducted to evaluate Fish Protein Hydrolysate (FPH) as a protein source in starter diets for pigs. A total of 552 weaned pigs were used in three growth trials and one digestion study. All three growth trials were designed to determine the effect of FPH with and without dried whey on starter pig performance. The digestion study was designed to determine the effect of FPH with and without dried whey on nutrient digestibility.

Adding 3% FPH to starter pig diets resulted in an improvement (8-17%) in average daily gain (ADG) over a corn-soybean meal basal diet. Feed efficiency and average daily feed intake (ADFI) were not affected by the addition of FPH. Dried whey additions with or without FPH resulted in no improvement over performance observed with the 3% FPH diet in either Trial 1 or Trial 3. In Trial 4, 20% dried whey added to a corn-soybean meal diet improved performance for all criteria measured to a level equal to that with 3% FPH alone. Growth responses to the addition of dried whey were inconsistent from trial to trial, possibly because whey utilization may have been impaired by heat damage to the dried whey. Therefore, conclusions regarding dried whey additions with or without FPH may be confounded with dried whey quality.

The digestibility study indicated no apparent difference for any of the criteria measured between the FPH diets and the basal diet. However, the addition of dried whey resulted in improved dry matter digestibility and digestible energy over the basal diet. There were no differences observed for digestible crude protein or percent nitrogen retention.

Introduction

Fish Protein Hydrolysate is the dried enzymatic digest of clean, undecomposed, whole fish or fish cuttings subjected to a hydrolytic enzyme process. The product is free of bones, scales, and undigested solids as well as most of the oil. The hydrolytic process is carefully controlled such that proteins are not split to free amino acids, but are processed to small polypeptide chains. Theoretically, the addition of FPH to starter diets would provide partially predigested proteins and give the young animal a "head start" on the digestive process. It is assumed that protein hydrolytically broken down by enzymes into short chains of amino acids has increased protein availability and subsequent digestibility. As can be seen from the analysis (Table 1), FPH contains 84% protein and appears to be an excellent source of lysine, tryptophan, and threonine.

There is currently renewed interest in replacing soybean meal with other protein sources for pigs weaned at 3 weeks of age. Composition and complexity of the diet is frequently discussed in relation to postweaning pig performance. Several studies done recently in Canada and the United States have indicated that pigs weaned at 3 weeks of age performed best when fed complex diets; however, the economics of feeding a complex diet must be evaluated on an individual basis. This study was conducted to evaluate the effect of FPH, as part of a semi-complex and a complex diet in a starter diet for the early weaned pig.

Experimental Procedures

Pigs averaging 22 days of age were moved from a total confinement, environmentally controlled, farrowing facility into one room of an environmentally controlled nursery. Pigs were housed in pens (4 ft x 5 ft) with woven wire floors over a Y-flush gutter, with one nipple waterer and one four-hole, self-feeder per pen. Temperature and air flow were adjusted to maintain optimum comfort for the pigs.

All four trials utilized the same basal corn-soybean meal diet (Table 2), containing 4% added fat, .3 ppm selenium, and 250 ppm copper sulfate, representing a "simple" diet. This diet was formulated to contain 21% crude protein, .9% calcium, .7% phosphorus, and 1.26% lysine. All diets were formulated on an isolysine basis.

In all three growth trials, pigs were blocked by weight and randomly assigned to pens, each pen being randomly assigned to a treatment. Each growth trial lasted 5 weeks. Criteria measured were averaged daily gain (ADG), average daily feed intake (ADFI), and feed efficiency expressed as feed/gain (F/G). Pigs were fed ad libitum. Feeders were checked twice daily and all feed additions recorded. Individual pigs weights were collected at the end of each 7-day period.

Trial 1. This trial was designed to determine the optimum feeding level of FPH with and without whey. In this trial, 180 3-week old weanling pigs weighing an average of 13.0 lb were used in 2 x 3 factorial design with two levels of dried whey (0 and 20%) and three levels of FPH (0, 3, and 6%). Animal health was excellent throughout the trial period.

Trial 2. Trial 2 was a digestion study, conducted concurrently with Trial 1. It was designed to evaluate the effect of FPH with and without dried whey on nutrient digestibility. Dry matter digestibility (DMD), digestible crude protein (DCP), digestible energy (DE), as well as percent nitrogen retention (%NRET) were evaluated. A cross-over design was utilized with diets formulated to contain two levels of dried whey (0 and 20%) and two levels of FPH (0 and 6%). Twelve pigs, with an average initial weight 13.7 lb were used with two 5-day collection periods. Each collection period was preceeded by a 5-day adaptation period.

Trial 3. This trial was designed to determine if part of the dried whey in a 20% dried whey starter diet could be replaced by FPH. Trial 3 was a growth trial using 120 3-week old weanling pigs weighing an average of 13.2 lb in a 3 x 2 factorial design with three levels of dried whey (0, 10 and 20%) and two levels of FPH (0 and 3%). Animal health was excellent throughout the trial period.

Trial 4. Trial 4 was designed to determine if the effect of FPH noted at the end of 5 weeks could be achieved by feeding FPH for only the first 2 weeks. Trial 4 used 240 3-week old weanling pigs, weighing an average of 13.2 lb. Diets were formulated to contain two levels of whey (0 and 20%) and two levels of FPH (0 and 3%).

Treatments are shown below:

Treatment	Diet (wk 1-2)	Diet (wk 3-5)
1	Basal	Basal
2	Basal + 3% FPH	Basal
3	Basal + 3% FPH	Basal + 3% FPH
4	Basal + 20% Dried Whey	Basal
5	Basal + 3% FPH + 20% Dried Whey	Basal
6	Basal + 3% FPH + 20% Dried Whey	Basal + 3% FPH +20% Dried Whey

Results and Discussion

Trial 1. Addition of FPH to starter diets did not affect ADG by week 2 of the trial. However, by the end of week 5, a quadratic ($P<.08$) improvement in ADG was observed with the 3% FPH diet showing an improvement over the 6% FPH and the basal diet (Table 3). Adding FPH at either 3 or 6% of the diet had no effect on ADFI or F/G. Addition of 20% dried whey had no effect on ADG, F/G, or ADFI. This is in contrast to numerous studies done at Kansas State and other universities, demonstrating the beneficial effects of dried whey addition to starter pig diets. The lack of a dried whey response possibly was due to a poor quality whey in these diets.

Trial 2. Addition of 20% dried whey resulted in improved ($P<.01$) DMD and DE utilization (Table 4). However, the addition of 20% dried whey had no effect on CPD or % NRET. The increase in DE from dried whey additions indicate that it may be the lactose portion of the dried whey improving the DMD, since lactose is the major energy source in dried whey. FPH had no effect on any of the digestibility criteria measured.

Trial 3. Addition of 3% FPH resulted in no improvement in ADG by week 2 (Table 5). Again, as demonstrated in Trial 1, by the fifth week the 3% FPH diet without dried whey improved ($P<.05$) ADG 17% over the basal diet. Additions of dried whey to the diet with or without FPH resulted in a slight improvement in ADG compared to the control diet. Dried whey additions yielded ADG responses between the basal diet and the 3% FPH diet without dried whey. Addition of either dried whey or FPH to a corn-soybean meal diet resulted in no improvement in ADFI or F/G.

Trial 4. Similar to results in Trials 1 and 3, the addition of 3% FPH without dried whey did not improve ADG by the end of the first 2 weeks after weaning. However, by the end of week 5, adding 3% FPH again resulted in a 10% improvement in ADG (P=.06). The addition of 20% dried whey resulted in ADG equal to the response from 3% FPH. Additions of 3% FPH together with 20% dried whey improve ADG by 22% over the basal diet and 11% over diets containing either 3% FPH or 20% dried whey. Again, results indicate no additional advantage in ADG to feeding the 20% dried whey plus 3% FPH diet beyond the second week postweaning. Based on these results, feeding a diet with 3% FPH for 2 weeks after weaning appeared to give equal performance to feeding FPH during the entire 5-week trial. Since the 3% FPH diet is more expensive than the control diet, feeding FPH for only the first 2 weeks compared to 5 weeks after weaning would greatly reduce the cost of gain.

Feed/Gain was improved similarly by all treatments compared to the basal diet. Adding dried whey resulted in most of the improvement in F/G by the end of the second week. Adding 3% FPH resulted in a slight improvement in F/G by the end of the fifth week. However, F/G was not different from FPH or dried whey additions (P>.05).

Feed intake was increased (P<.05) by the addition of 20% dried whey with 3% FPH by the end of the second week. This advantage was then maintained through the fifth week. Results indicate no advantage in starter pig performance from feeding the 20% dried whey plus 3% FPH diet beyond the second week postweaning.

Table 1. Fish Protein Hydrolysate - Analysis.

Item	Content
Dry Matter	96.0%
Crude Protein	84.0%
Crude Fat	5.0%
Metabolizable Energy	1747 kcal/lb
Calcium	0.15%
Total Phosphorus	0.60%
Lysine	6.10%
Tryptophan	0.75%
Threonine	3.50%

Table 2. Basal Diet Composition.[a]

Ingredient	Percent
Corn	55.11
Soybean Meal	36.74
Fat	4.00
Selenium	.15
Copper Sulfate	.10
Vitamins and Minerals	3.90
	100.00

[a]Calculated to contain: protein 21%, calcium .9%, phosphorus .7%, lysine 1.26%.

Table 3. The Effect of FPH with and without Whey in Starter Diets for Pigs (Trial 1).[a]

Item	FPH%:	0	3	6	0	3	6
	Dried whey %:	0	0	0	20	20	20
ADG wk 0-2[b]		.34	.36	.35	.35	.39	.37
ADG wk 0-5		.79	.82	.76	.77	.87	.82
ADFI wk 0-2		.79	.78	.72	.72	.80	.76
ADFI wk 0-5		2.38	2.17	2.15	2.08	2.24	2.06
F/G wk 0-2		1.64	1.54	1.49	1.44	1.47	1.51
F/G wk 0-5		1.58	1.51	1.51	1.52	1.48	1.53

[a]6 pigs/pen; 5 pens/treatment.
[b]Quadratic response from the addition of FPH, P=.08.

Table 4. The Effect of FPH with and without Whey on Digestibility in Starter Diets for Pigs (Trial 2).

Item	FPH%:	0	6	0	6
	Dried whey %:	0	0	20	20
DMD[a]		82.2	82.4	85.0	86.0
DCP		82.4	82.5	83.6	83.8
DE[a]		82.7	82.1	84.4	85.4
%NRET		60.2	64.3	63.9	65.7

[a]Effect of dried whey addition, P<.01.

Table 5. The Effect of FPH with and without Whey in Starter Diets for Pigs (Trial 3).[1]

Item	FPH%:	0	3	0	3	0	3
	Dried whey %:	0	0	10	10	20	20
ADG[2] wk 0-2		.50[a]	.57[b]	.53[ab]	.48[ab]	.53[a]	.54[ab]
ADG wk 0-5		.86[a]	1.01[b]	91[ab]	.93[ab]	.93[a]	.92[ab]
ADFI wk 0-2		.62	.68	.64	.82	.85	.68
ADFI wk 0-5		1.32	1.45	1.32	1.41	1.43	1.34
F/G wk 0-2		1.27	1.20	1.20	1.68	1.55	1.28
F/G wk 0-5		1.55	1.43	1.45	1.45	1.52	1.46

[1] 4 pigs/pen; 5 pens/treatment.
[2] Effect of dietary treatment, P<.05.

Table 6. The Effect of Duration on Feeding FPH with and Without Dried Whey in Starter Diets for Pigs (Trial 4).[1]

		Period[2]									
		1	2	1	2	1	2	1	2	1	2	1	2
	FPH %:	0	0	3	0	3	3	0	0	3	0	3	3
Item	Dried whey %:	0	0	0	0	0	0	20	0	20	0	20	30
ADG[3] wk 0-2		.29[a]		.31[ab]		.34[ab]		.39[bc]		.41[c]		.45[c]	
ADG[3] wk 0-5		.74[a]		.80[b]		.82[b]		.85[bc]		.84[bc]		.90[c]	
ADFI[4] wk 0-2		.46[a]		.44[a]		.46[a]		.52[ab]		.58[b]		.60[b]	
ADFI[5] wk 0-5		1.14[a]		1.15[a]		1.18[a]		1.27[ab]		1.29[b]		1.35[b]	
F/G[4] wk 0-2		1.61[a]		1.46[ab]		1.44[ab]		1.32[b]		1.42[ab]		1.36[b]	
F/G[4] wk 0-5		1.55[a]		1.44[b]		1.43[b]		1.50[ab]		1.52[ab]		1.50[ab]	

[1] 8 pigs/pen; 5 pens/treatment.
[2] Period: 1 = wk 0 through wk 2; 2 = wk 3 through wk 5.
[3] Effect of dietary treatment, P<.06.
[4] Effect of dietary treatment, P<.05.
[5] Effect of dietary treatment, P<.08.